# PATENT ABSTRACTS OF JAPAN

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(54) CERAMIC HEATER

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent an external terminal from separating caused by repetitive rise and fall of the temperature by forming a metal terminal consisting of a sinter of a molding made of metal particles having specific particle sizes, at each end of a heat emitting resistor member embedded in a ceramic heater.
SOLUTION: A heat emitting resistor member consisting of a high melting point metal is formed on the surface of a molding of insulative ceramics. A molding formed from particles of a high melting point metal having a mean particle size ranging from 0.1 to 100 $\mu$ m is overlapped on each end part of this resistor member, Further thereover a ceramic powder is put as filling and pressurized or a molding of ceramic powder is laid over followed by pressurization. The obtained molding with the resistor embedded is subjected to a sintering process, and the end parts of the embedded resistor are ground so that the metal terminal is exposed, and the exposed terminal and an external terminal are brazed together so that a ceramic heater is constructed. Because the exposed area of metal terminal is large, the connection with the external terminal can be established easily and strongly.

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CLAIMS

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[Claim(s)]
[Claim 1] The ceramic heater characterized by forming the metal terminal which comes to sinter the Plastic solid with which mean particle diameter becomes the ends part of said exoergic resistor from the metal particles which are 0.1-100 micrometers in the ceramic heater which laid the exoergic resistor under the interior of the base which consists of substantia-compacta ceramics.
[Claim 2] The ceramic heater according to claim 1 characterized by a base consisting of insulating ceramics, such as alumimium nitride, silicon nitride, sialon, and an alumina.
[Claim 3] The ceramic heater according to claim 1 or 2 to which an exoergic resistor is characterized by consisting of refractory metals, such as molybdenum, a tungsten, and platinum.
[Claim 4] The ceramic heater according to claim 1, 2, or 3 characterized by a metal terminal consisting of refractory metals, such as molybdenum, a tungsten, and platinum.

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[Translation done.]

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the ceramic heater which comes to lay an exoergic resistor underground in a ceramic base about a ceramic heater.
[0002]
[Description of the Prior Art] The former and a ceramic heater were produced by carrying out low attachment of the external terminal which becomes the ends of the exoergic resistor which was made to expose the ends part of an exoergic resistor to a base side face, and was exposed from nickel etc. while laying underground the exoergic resistor which consists of a tungsten and molybdenum in the base which consists of ceramics, such as aluminium nitride and a nitriding silicon.
[0003]
[Problem(s) to be Solved by the Invention] However, since [ that the thickness of a resistor is as thin as dozens of micrometers or less ] low attachment by this external terminal and the exoergic resistor edge had a small exposure area, its bonding strength by low attachment was weak, and it had the problem that an external terminal exfoliated, by the rising and falling temperature of a repeat.
[0004] This invention is made in view of the technical problem which the conventional ceramic heater mentioned above has, and the object is in offering the ceramic heater in which an external terminal does not exfoliate by the rising and falling temperature of a repeat, either.
[0005]
[Means for Solving the Problem] In order to attain the above-mentioned object, as a result of inquiring wholeheartedly, when forming the metal terminal with thick thickness in the edge of an exoergic resistor, this invention person etc. acquired knowledge that the area which a resistor edge exposes becomes large and Low attachment by the external terminal becomes firm, and completed this invention.
[0006] Namely, this invention is set to the ceramic heater which laid the exoergic resistor under the interior of the base which consists of (1) substantia-compacta ceramics. It considers as the ceramic heater (claim 1) characterized by forming the metal terminal which comes to sinter the Plastic solid with which mean particle diameter becomes the ends part of said exoergic resistor from the metal particles which are 0.1-100 micrometers. (2) bases Moreover, aluminium nitride, silicon nitride, sialon, It considers as the ceramic heater (claim 2) according to claim 1 characterized by consisting of insulating ceramics, such as an alumina. Furthermore, it considers as the ceramic heater (claim 3) according to claim 1 or 2 to which (3) exoergic resistor is characterized by consisting of refractory metals, such as molybdenum, a tungsten, and platinum. (4) metal terminal makes it a summary to consider as the ceramic heater (claim 4) according to claim 1, 2, or 3 characterized by consisting of refractory metals, such as molybdenum, a tungsten, and platinum, further again. It explains to a detail further below.
[0007] As ceramics which is the above-mentioned base, it considered as ceramics, such as aluminium nitride, silicon nitride, sialon, and an alumina. Since it can insulate with the exoergic resistor inside a base, all of these ceramics are desirable. In it, especially since thermal conductivity is high, and aluminium nitride is excellent in a temperature-up property and soak



nature, it is desirable.
[0008] Moreover, as the above-mentioned exoergic resistor, each sintering temperature of said ceramics was high, and since a refractory metal was needed, it considered as the exoergic resistor which consists of molybdenum, a tungsten, platinum, etc. Although especially the configuration of an exoergic resistor is not limited, the shape of a ctenidium, a curled form, etc. are used, for example.
[0009] Since it was the same with an exoergic resistor and the refractory metal was required as a metal terminal formed in the edge of an exoergic resistor, it considered as the metal terminal which consists of molybdenum, a tungsten, platinum, etc. What is necessary is just to thicken thickness of this metal terminal within limits which do not cause trouble, since Low attachment by the thick forge-fire external terminal becomes firm. However, since the thickness of this metal terminal becomes thick far from an exoergic resistor, it is necessary to make it match with contraction of the ceramics of a base. It is desirable to accomplish the metal particles which have a suitable particle size which suits contraction of a base for that purpose with a Plastic solid, and to sinter them. If a suitable particle size of the metal particles has desirable 0.1-100 micrometers at mean particle diameter and it is finer than 0.1 micrometers, contraction will become large compared with a ceramic base, and a crack will go into a base edge. Conversely, if coarser than 100 micrometers, since sintering will not progress but the touch area between particles will become small, the electric resistance of a terminal area increases and generation of heat with a terminal becomes large.
[0010]
[Embodiment of the Invention] If the manufacture approach of the above-mentioned ceramic heater is described, a Plastic solid will be first produced using the ceramic powder of necessary construction material. The exoergic resistor which consists of a necessary refractory metal is formed on the field of the Plastic solid at a configuration predetermined by the metallic foil or printing, and thickness. The Plastic solid of the predetermined thickness formed by the refractory metal particle whose mean particle diameter is 0.1-100 micrometers is put on the ends part of this exoergic resistor. The Plastic solid which filled up with and pressurized the still more nearly same ceramic powder on it, or pressurized the Plastic solid of the same ceramic powder in piles, and laid the exoergic confrontation object underground is produced, and the Plastic solid is sintered by the approach of common use. The grinding process of the ends part of the exoergic resistor currently laid under the obtained sintered compact is carried out, the metal terminal of an edge is exposed, low attachment of the exposure terminal and external terminal is carried out, and a ceramic heater is produced.
[0011] Since the exposure area of the metal terminal formed in the above ceramic heater, then exoergic resistor edge is large and it joins firmly while junction for an external terminal becomes easy, it can consider as the ceramic heater in which an external terminal cannot exfoliate easily.
[0012]
[Example] Hereafter, the example of this invention is concretely given with the example of a comparison, and this invention is explained more to a detail.
[0013] (1) One shaft of mixed powder of 97 % of the weight of production (example 1) aluminium nitride powder of a ceramic heater and 3 % of the weight of yttria powder was pressurized, and the Plastic solid was produced. The exoergic resistor shown in a table 1 was formed on the field of this Plastic solid. It produced that the metal particles which show the Plastic solid of a metal terminal in a table 1 independently with this were also, and the Plastic solid was put on the edge top face of a resistor. After filling up this upper part with aluminium nitride powder furthermore, the Plastic solid which carried out 1 shaft application of pressure, and laid the exoergic resistor underground was acquired.
[0014] Hotpress sintering of this Plastic solid was carried out, the grinding process of the edge of the exoergic resistor of that sintered compact was carried out, and the metal terminal was exposed. The hard soldering opium poppy and the ceramic heater were produced for the external terminal by Ag-Cu system low material for this exposure terminal.
[0015] (Example 2) The binder was added to 90 % of the weight of nitriding silicons, 5 % of the





weight of aluminas, and the mixed powder of 5 % of the weight of yttrias, it considered as the slurry, the green sheet with a thickness of 1mm was produced with the doctor blade method, and the exoergic resistor shown in a table 1 was formed on the field. After having fabricated the metal terminal independently shown in a table 1, putting the Plastic solid on the edge top face of a resistor and piling up the still more nearly same green sheet as the upper part, the layered product which carried out thermocompression bonding and laid the exoergic resistor underground was obtained.
[0016] After [ cleaning ] ordinary pressure sintering of this layered product was carried out, the metal terminal was exposed like the example 1, low attachment of the external terminal was carried out at that terminal, and the ceramic heater was produced.
[0017] (2) rising and falling temperature was repeated for the assessment profit **** ceramic heater between 20 degrees C and 500 degrees C, and the desquamative state of an external terminal was observed visually. The result is shown in a table 1.
[0018] (Examples 1-3 of a comparison) The example 1 of a comparison produced and estimated the ceramic heater which does not form a metal terminal in the example 1 for the comparison. Moreover, using the raw material powder of an example 2, mean particle diameter of metal particles was made finer than this invention, and the example 2 of a comparison produced and estimated the ceramic heater like the example 1. Furthermore, alumina powder was used for the raw material of a base, mean particle diameter of metal particles was made coarser than this invention, and the example 3 of a comparison produced and estimated the ceramic heater like the example 2. Those results are shown in a table 1.
[0019]
[A table 1]

| | | 基体 | 発熱抵抗体 | | | | 金属端子 | | | | | 評価 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 材質 | 材質 | 形状 | 幅×厚さ μm×μm | 形成方法 | 材質 | 平均粒径 μm | 幅×厚さ mm×mm | 接合方法 | 露出面積 幅×厚さ mm×mm | 昇降温回数 |
| 実施例 | 1 | AlN | Mo | [illegible] | 20×25 | [illegible] | Mo | 1.0 | 20×2 | [illegible] | 21×1.7 | 10000回剥離無し |
| | 2 | Si3N4 | W | [illegible] | 10×10 | 印刷 | W | 13 | 30×1 | ドクターブレード | 8×0.8 | 10000回剥離無し |
| 比較例 | 1 | AlN | W | [illegible] | 20×21 | [illegible] | – | – | – | – | 20×0.025 | 30回剥離 |
| | 2 | Si3N4 | Mo | [illegible] | 30×30 | [illegible] | W | 0.05 | 30×2 | [illegible] | 32×1.7 | 金属端子亀裂発生 |
| | 3 | Al2O3 | Pt | [illegible] | 10×10 | 印刷 | Pt | 230 | 10×1 | ドクターブレード | 8×0.8 | 金属端子異常発熱 |

[0020] Even if each repeated rising and falling temperature 10000 times, in examples 1-2, an external terminal did not exfoliate, so that clearly from a table 1.





[0021] On the other hand, in the example 1 of a comparison, since the metal terminal was not formed, the plane-of-composition product with an external terminal was small, and exfoliation was accepted by the repeat which is 30 times. Moreover, in the example 2 of a comparison, since sintering contraction of a metal terminal was large, the crack occurred in the terminal area. Furthermore, in the example 3 of a comparison, when the current was impressed to the ceramic heater, abnormality generation of heat was accepted in the terminal area.
[0022]
[Effect of the Invention] Since the exposure area of the metal terminal formed in the exoergic resistor edge was large according to the ceramic heater which starts this invention as above and it joined firmly while junction for an external terminal becomes easy, it was able to consider as the ceramic heater in which an external terminal does not exfoliate even if it carries out repeat rising and falling temperature.

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# CERAMIC HEATER


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| **Inventor:** | ISHII MAMORU; TAKAHASHI HEISHIRO; TSUKAMOTO KEIZO |
| **Applicant:** | NIHON CEMENT |
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Abstract of **JP9306642**

PROBLEM TO BE SOLVED: To prevent an external terminal from separating caused by repetitive rise and fall of the temperature by forming a metal terminal consisting of a sinter of a molding made of metal particles having specific particle sizes, at each end of a heat emitting resistor member embedded in a ceramic heater. SOLUTION: A heat emitting resistor member consisting of a high melting point metal is formed on the surface of a molding of insulative ceramics. A molding formed from particles of a high melting point metal having a mean particle size ranging from 0.1 to 100&mu m is overlapped on each end part of this resistor member, Further thereover a ceramic powder is put as filling and pressurized or a molding of ceramic powder is laid over followed by pressurization. The obtained molding with the resistor embedded is subjected to a sintering process, and the end parts of the embedded resistor are ground so that the metal terminal is exposed, and the exposed terminal and an external terminal are brazed together so that a ceramic heater is constructed. Because the exposed area of metal terminal is large, the connection with the external terminal can be established easily and strongly.

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(54)【発明の名称】　セラミックヒータ

(57)【要約】
【課題】　セラミックヒータは、内蔵する発熱抵抗体の厚さが薄く露出面積が小さいため、外部端子とのロウ付け強度が弱く、繰り返しの昇降温により、外部端子が剥離するという問題があった。
【解決手段】　緻密質セラミックスからなる基体内部に発熱抵抗体を埋設したセラミックヒータにおいて、前記発熱抵抗体の両端部分に平均粒径が0．1～100μmの金属粒子からなる成形体を焼結してなる金属端子が形成されていることとしたセラミックヒータ。

【特許請求の範囲】

【請求項１】 緻密質セラミックスからなる基体内部に発熱抵抗体を埋設したセラミックヒータにおいて、前記発熱抵抗体の両端部分に平均粒径が０．１～１００μｍの金属粒子からなる成形体を焼結してなる金属端子が形成されていることを特徴とするセラミックヒータ。

【請求項２】 基体が、窒化アルミニウム、窒化ケイ素、サイアロン、アルミナ等の絶縁セラミックスからなることを特徴とする請求項１記載のセラミックヒータ。

【請求項３】 発熱抵抗体が、モリブデン、タングステン、白金等の高融点金属からなることを特徴とする請求項１または２記載のセラミックヒータ。

【請求項４】 金属端子が、モリブデン、タングステン、白金等の高融点金属からなることを特徴とする請求項１、２または３記載のセラミックヒータ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、セラミックヒータに関し、特にセラミックス基体内に発熱抵抗体を埋設してなるセラミックヒータに関する。

【０００２】

【従来の技術】従来、セラミックヒータは、窒化アルミニウム、窒化けい素等のセラミックスからなる基体内に、タングステン、モリブデンからなる発熱抵抗体を埋設するとともに、発熱抵抗体の両端部分を基体側面に露出させ、露出した発熱抵抗体の両端にニッケル等からなる外部端子をロウ付けすることにより作製されていた。

【０００３】

【発明が解決しようとする課題】しかしながら、この外部端子と発熱抵抗体端部とのロウ付けは、抵抗体の厚さが数十μｍ以下と薄く露出面積が小さいため、ロウ付けによる接合強度が弱く、繰り返しの昇降温により、外部端子が剥離するという問題があった。

【０００４】本発明は、上述した従来のセラミックヒータが有する課題に鑑みなされたものであって、その目的は、繰り返しの昇降温によっても外部端子が剥離しないセラミックヒータを提供することにある。

【０００５】

【課題を解決するための手段】本発明者等は、上記目的を達成するため鋭意研究した結果、発熱抵抗体の端部に厚さの厚い金属端子を形成すれば、抵抗体端部の露出する面積が大きくなり、外部端子とのロウ付けが強固になるとの知見を得て本発明を完成した。

【０００６】即ち本発明は、（１）緻密質セラミックスからなる基体内部に発熱抵抗体を埋設したセラミックヒータにおいて、前記発熱抵抗体の両端部分に平均粒径が０．１～１００μｍの金属粒子からなる成形体を焼結してなる金属端子が形成されていることを特徴とするセラミックヒータ（請求項１）とし、また、（２）基体が、窒化アルミニウム、窒化ケイ素、サイアロン、アルミナ等の絶縁セラミックスからなることを特徴とする請求項１記載のセラミックヒータ（請求項２）とし、さらに、（３）発熱抵抗体が、モリブデン、タングステン、白金等の高融点金属からなることを特徴とする請求項１または２記載のセラミックヒータ（請求項３）とし、さらにまた、（４）金属端子が、モリブデン、タングステン、白金等の高融点金属からなることを特徴とする請求項１、２または３記載のセラミックヒータ（請求項４）とすることを要旨とする。以下さらに詳細に説明する。

【０００７】上記基体であるセラミックスとしては、窒化アルミニウム、窒化ケイ素、サイアロン、アルミナ等のセラミックスとした。これらのセラミックスは、基体内部の発熱抵抗体と絶縁できるのでいずれも好ましい。その中で、窒化アルミニウムは熱伝導性が高いことから、昇温特性、均熱性に優れているので特に好ましい。

【０００８】また、上記発熱抵抗体としては、前記セラミックスの焼結温度がいずれも高く、高融点金属が必要となるため、モリブデン、タングステン、白金等からなる発熱抵抗体とした。発熱抵抗体の形状は特に限定されないが、例えば、櫛歯状、渦巻き状等が使用される。

【０００９】発熱抵抗体の端部に形成される金属端子としては、発熱抵抗体と同じく高融点金属が必要であるため、モリブデン、タングステン、白金等からなる金属端子とした。この金属端子の厚さは、厚いほど外部端子とのロウ付けが強固になるため、支障を来さない範囲内で厚くすればよい。但し、この金属端子の厚さは、発熱抵抗体よりはるかに厚くなるため、基体のセラミックスの収縮にマッチングさせる必要がある。そのためには基体の収縮に合う適切な粒径を有する金属粒子を成形体と成して焼結するのが好ましい。その金属粒子の適切な粒径は、平均粒径で０．１～１００μｍが好ましく、０．１μｍより細かいと収縮がセラミックス基体に比べて大きくなり、基体端部に亀裂が入る。逆に１００μｍより粗いと、焼結が進まず粒子間の接触面積が小さくなるため、端子部の電気抵抗が増加し、端子での発熱が大きくなる。

【００１０】

【発明の実施の形態】上記セラミックヒータの製造方法を述べると、先ず所要の材質のセラミックス粉末を用いて成形体を作製する。その成形体の面上に所要の高融点金属からなる発熱抵抗体を金属箔、あるいは印刷等で所定の形状、厚さに形成する。この発熱抵抗体の両端部分に平均粒径が０．１～１００μｍの高融点金属粒子で形成された所定の厚さの成形体を重ねる。さらにその上に同じセラミックス粉末を充填、加圧するか、あるいは同じセラミックス粉末の成形体を重ねて加圧するなどして発熱対抗体を埋設した成形体を作製し、その成形体を慣用の方法で、焼結する。得られた焼結体に埋設されている発熱抵抗体の両端部分を研削加工し、端部の金属端子を露出させ、その露出端子と外部端子とをロウ付けして

セラミックヒータを作製する。

【0011】以上のセラミックスヒータとすれば、発熱抵抗体端部に形成された金属端子の露出面積が大きいので、外部端子との接合が容易となると共に、強固に接合するため、外部端子が剥離し難いセラミックヒータとすることができる。

【0012】

【実施例】以下、本発明の実施例を比較例と共に具体的に挙げ、本発明をより詳細に説明する。

【0013】（1）セラミックヒータの作製

（実施例１）窒化アルミニウム粉末９７重量％、イットリア粉末３重量％の混合粉末を一軸加圧して成形体を作製した。この成形体の面上に表１に示す発熱抵抗体を形成した。これとは別に金属端子の成形体を表１に示す金属粒子でもって作製し、その成形体を抵抗体の端部上面に重ねた。さらにこの上部に窒化アルミニウム粉末を充填した後、一軸加圧して発熱抵抗体を埋設した成形体を得た。

【0014】この成形体をホットプレス焼結し、その焼結体の発熱抵抗体の端部を研削加工して金属端子を露出させた。この露出端子に外部端子をＡｇ－Ｃｕ系ロウ材によりロウ付けし、セラミックヒータを作製した。

【0015】（実施例２）窒化けい素９０重量％、アルミナ５重量％、イットリア５重量％の混合粉末にバイン＊＊ダーを加えスラリーとし、ドクターブレード法により厚さ１ｍｍのグリーンシートを作製し、その面上に表１に示す発熱抵抗体を形成した。別に表１に示す金属端子を成形し、その成形体を抵抗体の端部上面に重ね、さらにその上部に同じグリーンシートを重ねた後、熱圧着して発熱抵抗体を埋設した積層体を得た。

【0016】この積層体を脱脂後常圧焼結し、実施例１と同様に金属端子を露出させ、その端子に外部端子をロウ付けしてセラミックヒータを作製した。

【0017】（２）評価

得られたセラミックヒータを２０℃と５００℃の間で昇降温を繰り返し、外部端子の剥離状態を目視で観察した。その結果を表１に示す。

【0018】（比較例１～３）比較のために比較例１では、実施例１に金属端子を形成しないセラミックヒータを作製し、評価した。また、比較例２では、実施例２の原料粉末を用い、金属粒子の平均粒径を本発明より細かくして実施例１と同様にセラミックヒータを作製し、評価した。さらに、比較例３では、基体の原料にアルミナ粉末を用い、金属粒子の平均粒径を本発明より粗くして実施例２と同様にセラミックヒータを作製し、評価した。それらの結果を表１に示す。

【0019】

【表１】

| | | 基体 | 発熱抵抗体 | | | | 金属端子 | | | | | 評価 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 材質 | 材質 | 形状 | 幅×厚さ mm×μm | 形成方法 | 材質 | 平均粒径 μm | 幅×厚さ mm×mm | 成形方法 | 露出面積 幅×厚さ mm×mm | 昇降温回数 |
| 実施例 | 1 | AlN | Mo | 櫛歯 | 20×25 | 箔 | Mo | 1.0 | 20×2 | ﾌﾟﾚｽ | 21×1.7 | 10000回剥離無し |
| | 2 | $Si_3N_4$ | W | 渦巻 | 10×10 | 印刷 | W | 10 | 10×1 | ﾄﾞｸﾀｰﾌﾞﾚｰﾄﾞ | 8×0.8 | 10000回剥離無し |
| 比較例 | 1 | AlN | W | 櫛歯 | 20×25 | 箔 | − | − | − | − | 20×0.025 | 30回剥離 |
| | 2 | $Si_3N_4$ | Mo | 渦巻 | 30×30 | 箔 | W | 0.05 | 30×2 | ﾌﾟﾚｽ | 32×1.7 | 金属端子亀裂発生 |
| | 3 | $Al_2O_3$ | Pt | 渦巻 | 10×10 | 印刷 | Pt | 200 | 10×1 | ﾄﾞｸﾀｰﾌﾞﾚｰﾄﾞ | 8×0.8 | 金属端子異常発熱 |

【0020】表1から明らかなように、実施例1～2においては、いずれも昇降温を10000回繰り返しても外部端子が剥離しなかった。

【0021】これに対して比較例1においては、金属端子を形成していないため、外部端子との接合面積が小さく、30回の繰り返しで剥離が認められた。また、比較例2では、金属端子の焼結収縮が大きいため端子部に亀裂が発生した。さらに、比較例3では、セラミックヒータに電流を印加したところ、端子部に異常発熱が認められた。

【0022】

【発明の効果】以上の通り、本発明にかかるセラミックヒータによれば、発熱抵抗体端部に形成した金属端子の露出面積が大きいので、外部端子との接合が容易となると共に、強固に接合するため、繰り返し昇降温しても外部端子が剥離しないセラミックヒータとすることができた。